Q&A on *Cryptosporidium*

Questions & Answers

Office of Water Programs Staff Technical Bulletin

For internal distribution only

Pub. No. TB-DWSE-95-2 January 10, 1995

1. What is *Cryptosporidium*?

Cryptosporidium, first described in 1907, was not recognized as a cause of human illness until 1976. The protozoan *Cryptosporidium parvum* is the causative agent for the gastrointestinal disease, cryptosporidiosis, in man and animals. Upon infection, this protozoan resides principally in the gastrointestinal tract and goes through its life stages as an intracelluar parasite. In the intestines, it forms oocysts (which have some similarity to parasite eggs) which are shed in feces and which are the source of infection for new susceptible persons.

Cryptosporidiosis in animals (e.g., cattle) and man is typically transmitted by the fecal-oral route and can be widely disseminated by water where drinking untreated or undertreated water occurs. The oral infectious dose for man is thought to be less than 10 oocysts, but further studies are needed to confirm this. Evidence for waterborne dissemination and infection can be found in several recent outbreaks, each potentially involving hundreds or thousands of persons: Thames River in England, Medford, Oregon, and Milwaukee, Wisconsin.

Cryptosporidium can be transmitted from person to person or from farm livestock, such as cattle, sheep or pigs, to humans through the fecal-oral route (Casemore, 1990). Wild animals do not appear to be important reservoirs for humans (Fayer et al., 1990). Ingestion of drinking water contaminated with oocysts is the major mode of transmission. Fecal contamination of food, clothing, bedding or recreational waters (e.g., swimming pools) are also routes of transmission.

2. What is the occurrence of *Cryptosporidium* in source waters?

Cryptosporidium oocysts represent a real challenge to water treatment systems. They are very resistant to conventional disinfection practices (e.g., chlorination). Their occurrence and levels in water are quite variable, therefore, they are not always present during monitoring. However, they are found in surface waters of every region of the U.S. and provide endemic disease levels in a number of developing countries. The oocysts are more difficult to remove by filtration processes than *Giardia* cysts (6-12 micron diameter) because they are smaller in size (4-6 micron diameter). Additionally, conventional disinfection of the oocysts with chlorine at typical water utility treatment concentrations of 2-3 mg/L free available chlorine, even for a several hour exposure period, has almost no effect in disinfecting the oocysts. In fact, one of the methods used to prepare purified oocysts from environmental samples is to add up to 100 mg/L of chlorine for short periods of time to kill all other microorganisms and recover the cysts. In surface waters, the infectious oocysts can survive for weeks, especially at low temperatures. Due to natural filtration in the soil, groundwater sources typically are free of the oocysts.

3. What are the health effects and medical treatment of cryptosporidiosis?

Symptoms of cryptosporidiosis in healthy people typically includes nausea, diarrhea, and cramps that can last up to several weeks. There currently is no truly effective antibiotic treatment for cryptosporidiosis, but the disease will generally subside on its own. However, persons having compromised immune systems may have chronic cryptosporidiosis which may persist for months.

4. What is the necessary treatment?

To provide the most effective barrier possible against *Cryptosporidium* and *Giardia* cysts, water utility managers and engineers should look at their facilities and operating procedures with the objective of improving the quality of treated water as much as is feasible. It may seem expensive to use a filter aid polymer or a higher coagulant dose, to backwash filters longer or sooner, to always wash a filter before it is returned to service, or to install continuous turbidimeters. However, these expenses are minor compared with those associated with an outbreak. Funds spent on process improvements can help to buy not only better water quality, but also the peace of mind that comes from not having an outbreak with which to to contend. In the field of public health, providing effective prevention is a better alternative than bringing about a cure. Properly designed, carefully operated, well-maintained water treatment facilities are extremely effective barriers to waterborne disease. The recent cryptosporidiosis problems are a reminder that water professionals have an obligation to the public to always do their best to maintain those barriers.

Some alternative disinfectants such as ozone appear to have some increased ability over free chlorine to disinfect the cysts, but further studies on alternative disinfectants are underway.

Focus on standards of performance. We never can reach absolute zero with microbial concentrations. The performance of the treatment plant is best evaluated by comparing the source water with the filtered water. For source water turbidities consistently above 5 NTU, the log reduction in turbidity from source water to filtered water can give a reasonably good indication of log removal of cyst-sized particles (either *Cryptosporidium* or *Giardia*). However, for cleaner source waters with turbidities less than about 5 NTU, turbidity reduction becomes an increasingly inadequate predictor of overall particle reduction. While continuing to use turbidity measurements, plants treating low-turbidity (<5 NTU) source waters will find it necessary to use particle counting to obtain any reasonable indication of log reduction of cyst-sized particles.

Football games are won by blocking and tackling, proper execution of fundamentals. Safe water is produced by proper execution of fundamental treatment processes. Now is not the time for complacency, now is the time for increased vigilance. Reliability and consistency of treatment is the key. This means that sufficient resources need to be allocated for operation, maintenance and capital improvements. See attachment - Assessing Treatment Plant Performance

5.How do you test for *Cryptosporidium*?

The simple answer is by observing them through a microscope. See attachment for Supplement to the 18th Edition of Standard Methods.

6. Why don't we test regularly for Cryptosporidium?

It has been recognized as a significant waterborne pathogen only in the past 5-6 years and we have only recently developed the water sampling and monitoring methods necessary for its detection and quantification.

Until fairly recently, we have considered the coliform indicators as reliable indicators of fecal contamination. *Cryptosporidium* is one of the pathogens that has indicated that these indicators are not always adequate to detect fecal contaminants. Water sampling and identification techniques for *Cryptosporidium* have the following limitations that affect the interpretation of collected data:

- The assay does not effectively differentiate viability (infectivity of oocysts).

- The assay is not species specific (only *C. parvum* species is infectious in man).

- Strain (virulence) differences have not been definitively demonstrated among *C. parvum*

- The technique is labor intensive, requires microscoptists with substantial expertise, and is costly.

- The recovery efficiency and sensitivity of the method is quite low and extremely variable.

- A negative result does not necessarily indicate that the tested water is free of Cryptosporidium oocysts.

7. What action should be taken if *Cryptosporidium* is found in treated water?

Cryptosporidium tests results should be made available to the public when appropriate. Public water systems should notify affected individuals and especially immuno-compromised persons on how to reduce risks of cryptosporidiosis and measures they can take to ensure their drinking water is safe. Boil water advisories can reduce risks of waterborne diseases, but this procedure can increase costs (food and beverage industries, tourism, increases in energy use), erode public confidence, and divert public health resources. Confirmation of *Cryptosporidium* oocysts in low levels of drinking water, alone, should not trigger a Boil Water Advisory unless supported by public water system inspection results indicating a breakdown in unit processes, water quality data and/or epidemiological data. Likewise, oocyst presence/absence should not be the sole criterion for deciding if public water is again safe to drink.

If a Boil Water Advisory is issued, it should recommend that all water used for drinking and food preparation be brought to a rolling boil for one minute to eliminate risks of acquiring cryptosporidiosis.

NSF-approved point-of-use devices that are capable of removing particles less than 1 micron in diameter (NSF standard 42, Class I) or reverse osmosis filtration devices (NSF standard 58) will also remove *Cryptosporidium* oocysts from drinking water. Also, NSF Standard 53 certification for “cyst reduction” entails removal of particles in the 3-to-5 micron range; Therefore, *Cryptosporidium* removal capabilities of these devices are acceptable.

Vendors who pass water through NSF-approved submicron filters or reverse osmosis devices, prior to bottling, are considered safe. Bulk water vendors (for example, water dispensers in supermarkets) are considered safe for *Cryptosporidium* removal if the treatment unit involves properly maintained submicron or reverse osmosis filters; however, consumers should use clean containers to prevent contamination.

Persons who choose to use a point-of-use device or bottled water should be aware of the problems in selecting the appropriate product, lack of enforceable standards, costs, and difficulty in using theseproducts consistently for all water that is consumed or contacts food during meal preparation.

8. How is the Industry (waterworks, state, EPA, AWWA, ASDWA, etc) addressing this issue?

AWWA and the AWWA Research Foundation have committed $10.1 million to date for 35 research projects addressing *Cryptosporidium*. See below for AWWA 12-point plan to protect public health. EPA is currently reevaluating how we test and regulate our supplies. EPA hopes to propose an Information Collection Rule (ICR) which will monitor large and medium size water treatment plant source waters and also will monitor the filtration effectiveness of large systems for *Cryptosporidium*, *Giardia*, and enteroviruses, in addition to the standard microbial indicators.

Some water systems are currently monitoring for *Giardia* and *Cryptosporidium*. These data will help frame the future treatment requirements for microorganisms and monitoring needs to prevent waterborne disease outbreaks.

The AWWA 12-point plan to safe guard against *Cryptosporidium* advises utilities to:

- increase their vigilence through *Cryptosporidium* testing, turbidity monitoring, and particle counting.
- optimize water treatment processes to remove particulate matter and maintain finished-water turbidity levels below 0.1 ntu
- form an early warning system with drugstores and health clinics to alert the water supplier to excessive cases of gastrointestinal illness.
- develop a strong relationship with the health department to share information, concerns, and procedures on public illnesses.
- talk with the medical community community about testing patients for cryptosporidiosis, if needed.
- be open with customers and the media. Utilities should inform the public if *Cryptosporidium* is found.
- discuss with the medical community, health officials, and groups representing high-risk popu lations- such as the immune deficient and elderly- measures to take in the event of a health threat.
- prepare a detailed plan on how to notify customers and what to advise on the case of a health threat.
- consider reporting the "turbidity of the day" (similar to the air-pollution index) so that people can understand the potential risk each day if excess turbidities are repeated.
- form a citizens' advisory group to consider preferred, local long-term options to address the issue.
- tell customers that new information, such as the identification of *Cryptosporidium* as a ubiq uitous organism and the concerns about chlorine, requires new solutions and seek their help in determining the desired water quality levels and associated water rates.